

APPENDIX 1

GLOSSARY

A-E—Architect, Engineering Firm.

AMERICAN WIRE GAUGE (AWG)—The standard adopted in the United States for the measurement of wire sizes.

AMMETER—An instrument for measuring the amount of electron flow (in amperes).

AMPACITY—The current in amperes that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

AMPERE—The basic unit of electrical current

AMPLIFIER—The device that provides amplification (the increase in current, voltage, or power of a signal) without appreciably altering the original signal.

ANSI—American National Standards Institute.

BILL OF MATERIAL—A list of standard parts or raw materials needed to fabricate an item.

BLOCK DIAGRAM—A diagram in which the major components of a piece of equipment or a system are represented by squares, rectangles, or other geometric figures, and the normal order of progression of a signal or current flow is represented by lines.

BLUEPRINTS—Copies of electrical or other types of technical drawings. Although blueprints used to be blue, modern reproduction techniques now permit printing of black on white as well as colors.

BORDER LINES—Dark lines defining the inside edge of the margin on a drawing.

BREAK LINES—Lines to reduce graphic size of an object generally to conserve paper space. Two types: long, thin, ruled lined with freehand zigzag; short, thick, wavy freehand line.

CAPACITANCE—The property of an electrical circuit that opposes changes in voltage.

CAPACITOR—An electrical device capable of storing electrical energy in an electrostatic field

CBC—Construction Battalion Center.

CESE—Civil Engineering Support Equipment.

CESO—Civil Engineering Support Office System manager responsible for maintaining NCF Table of Allowance (TOA).

COMSECONDCNB—Commander, Second Naval Construction Brigade.

COMTHIRDCNB—Commander, Third Naval Construction Brigade.

CONDUCTOR—A material that easily permits electric current to flow.

CONTINUITY—An uninterrupted, complete path for current flow.

CRIBBING—The act of placing some firm material around the below ground portion of a power pole.

CTR—Central Tool Room.

CURRENT—The passage of electrons through a conductor, measured in amperes.

DEVICE—A part of an electrical system that is intended to carry electrical energy.

DIRECT SHORT—*See* SHORT CIRCUIT.

DoD—Department of Defense.

DYNAMOMETER—An instrument that measures the strain of the pull used in pole-line construction.

ELECTROLYTE—A solution of a substance that is capable of conducting electricity.

ELECTROMECHANICAL DRAWING—A special type of drawing combining electrical symbols and mechanical drawing to show the composition of equipment that combines electrical and mechanical features.

EPA—Environmental Protection Agency.

EQUIPMENT GROUNDING—The grounding of all exposed non-current carrying metal parts of an electrical system to the earth.

FEX—Field exercise.

FLUORESCENT LAMP—A low-pressure mercury electric-discharge lamp in which a fluorescing coating on its inner surface transforms some of the ultraviolet energy generated by the discharge into light.

GROUND—A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth.

GROUNDING CONDUCTOR—A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode.

GROUNDING ELECTRODE—A conductor embedded in the earth for maintaining ground potential on conductors connected to it.

HAZARDOUS LOCATION—An area where ignitable vapors or dust might cause a fire or explosion created by energy emitted from lighting or other electrical equipment.

HYDROMETER—An instrument used to measure specific gravity. In batteries, hydrometers are used to indicate the state of charge by the specific gravity of the electrolyte.

INDUCTANCE—The property of a circuit that tends to oppose a change in the existing current flow.

INDUCTION—The act or process of producing voltage and current by the relative motion of a magnetic field across a conductor.

INDUCTION MOTOR—A simple, rugged, ac motor with desirable characteristics. The rotor is energized by transformer action (induction) from the stator.

INSULATION—A material used to prevent the leakage of electricity from a conductor and provide mechanical spacing or support as protection against accidental contact with the conductor.

INSULATOR—A device having high electrical resistance; used for supporting or separating conductors so as to prevent undesired flow of current from the conductors to other objects.

ISOMETRIC WIRING DIAGRAM—A diagram showing the outline of a structure and the location of equipment, such as panels, and junction boxes, and cable runs.

MAINTENANCE—Day-to-day, periodic, or scheduled work required to preserve or restore a facility or equipment so that it can be used effectively for its designed purpose.

It includes work to prevent damage to or the deterioration of a facility that would otherwise be more costly to restore.

MEP—Mobile electric power.

MILITARY SPECIFICATIONS (MILSPEC)—Technical requirements and standards adopted by the Department of Defense that must be met by vendors selling materials to DoD.

MILITARY STANDARDS (MIL-STD)—Standards of performance for components or equipment that must be met to be acceptable for military systems.

MOCC—Mount-out control center.

MOTOR—A machine that converts electrical energy to mechanical energy. It is activated by ac or dc voltage, depending on the design.

MOTOR LOAD—Any device driven by a motor. Typical loads are drills, saws, water pumps, generators, and so forth. The speed and power capabilities of a motor must be matched to the speed and power capabilities of the motor load.

MOTOR STARTERS—Resistive devices placed in series with dc motor armatures to prevent the armature from drawing excessive current until armature speed develops counter emf.

MSDS—Material Safety Data Sheet. A mandatory form that should accompany any hazardous materials being issued to or used by naval personnel.

NAVFACENGCOM—Naval Facilities Engineering Command. Manages the planning, design, and construction of the U.S. naval facilities around the world.

NAVSUP—Naval Supply Command.

NCBC—Naval Construction Battalion Center.

NCF—Naval Construction Force.

NEC®—National Electrical Code®.

NFPA—National Fire Protection Agency.

OHM—The unit of electrical resistance; that value of electrical resistance through which a constant potential difference of 1 volt across the resistance will maintain a current flow of 1 ampere through the resistance.

OIC—Officer in charge.

OPEN CIRCUIT—A circuit that does not provide a complete path for the flow of current.

OPNAVINST—Instructions from the Chief of Naval Operations.

OSHA—Occupational Safety and Health Act.

P&E—Planning and estimating.

PHOTOCELL—A light-controlled variable resistor that has a light-to-dark resistance ratio of 1:1,000; used in various types of control and timing circuits.

PICTORIAL WIRING DIAGRAM—A diagram showing actual pictorial sketches of various parts of a piece of equipment and the electrical connections between the parts.

POLYPROPYLENE—Any various thermoplastic resins that are polymers of propylene. They are tough and hard and are used to make molded articles and fibers.

PREVENTIVE MAINTENANCE—Visual, mechanical, electrical, and electronic checks that are made to determine whether or not equipment is functioning properly.

PWC—Public Works Center.

PWD—Public Works Department.

RECEIVER—Equipment that converts electromagnetic energy into audible form.

RECTIFIER—A device that converts alternating current to direct current.

REGULATOR—The section in a basic power supply that maintains the output of the power supply at a constant level in spite of large changes in load current or input line voltage.

RELAY—An electromagnetic device with one or more sets of contacts that change position by the magnetic attraction of a coil to an armature.

RESISTANCE—The opposition of a device or material offers to the flow of current. The effect of resistance is to raise the temperature of the material or device carrying the current.

ROTOR—The revolving part of a rotating electrical machine. The rotor may be either the field or the armature, depending on the design of the machine.

SAFETY—Being safe from undergoing or causing injury, harm, or loss of personnel or equipment.

SCALE—The ratio between the measurement used on a drawing and the measurement of the object it represents.

SCHEMATIC DIAGRAM—A diagram using graphic symbols to show how a circuit functions electrically.

SHORT CIRCUIT—An unintentional current path between two components in a circuit or between component and ground; usually caused by a circuit malfunction (also known as direct short).

SINGLE-LINE DIAGRAM—A diagram using single lines and graphic symbols to simplify a complex circuit or system.

SLIP RINGS—Contacts that are mounted on the shaft of a motor or generator to which the rotor windings are connected and against which the brushes ride. Devices for making electrical connections between stationary and rotating contacts.

SOLID-STATE DEVICE—An electronic device that operates by the movement of electrons within a solid piece of semiconductor material.

SPECIFICATION—Detailed description or identification relating to quality, strength, or similar performance requirements.

STATOR—The stationary part of a rotating electrical machine. The stator may be either the field or the armature, depending on the design of the machine.

SYNTHETIC-FIBER LINE—A rope made from either nylon, polyester, polyethylene, or polypropylene.

TITLE BLOCK—A blocked area in the lower right corner of a print; provides information to identify the drawing, its subject matter, origins, scale, and other data

TOA—Table of Allowance. Personnel, equipment, and supplies needed for a particular NCF unit for that unit to function properly.

TRANSFORMER—A device composed of two or more coils, linked by magnetic lines of force; used to transfer energy from one circuit to another.

TROUBLESHOOTING—The process of locating and diagnosing faults in equipment by means of systematic checking or analysis.

UTILITY PLAN—A floor plan of a structure showing locations of heating, electrical, plumbing, and other service system components.

VOLTAGE—The term used to signify electrical pressure. Voltage is a force that causes current to flow through an electrical conductor.

WATT—The unit of electrical power that is the product of voltage and current.

WATT-HOUR—A practical unit of electrical energy equal to 1 watt of power for 1 hour.

WATT-HOUR METER—A meter used to measure electrical energy.

WATTMETER—A meter used to measure electrical power.

WHIPPING—The process of securing the ends of a fiber or wire rope to prevent the strands from unraveling.

WIRING (CONNECTION) DIAGRAM—A diagram showing the individual connections within a unit and the physical arrangement of the components.

29 CFR—Title 29 Code of Federal Regulations.

APPENDIX II

METRIC CONVERSION TABLES

Length Conversion

When You Know:	You Can Find:	If You Multiply By:
inches	millimeters	25.4
inches	centimeters	2.54
feet	centimeters	30
feet	meters	0.3
yards	centimeters	90
yards	meters	0.9
miles	kilometers	1.6
miles	meters	1 600
millimeters	inches	0.04
centimeters	inches	0.4
centimeters	feet	0.032 8
meters	feet	3.3
centimeters	yards	0.010 9
meters	yards	1.1
meters	miles	0.000 621
kilometers	miles	0.6
meters	nautical miles	0.000 54
nautical miles	meters	1852

Weight Conversion

When You Know:	You Can Find:	If You Multiply By:
ounces	grams	28.3
pounds	kilograms	0.45
short tons (2000 lbs)	megagrams (metric tons)	0.9
grams	ounces	0.035 3
kilograms	pounds	2.2
megagrams (metric tons)	short tons (2000 lbs)	1.1

Temperature Conversion

When You Know:	You Can Find:	If You Multiply By:
degrees Fahrenheit	degrees Celsius	subtract 32 then multiply by 5/9
degrees Celsius	degrees Fahrenheit	multiply by 9/5 then add 32
degrees Celsius	kelvins	add 273.15°

Volume Conversion

When You Know:	You Can Find:	If You Multiply By:
teaspoons	milliliters	5
tablespoons	milliliters	15
fluid ounces	milliliters	30
cups	liters	0.24
pints	liters	0.47
quarts	liters	0.95
gallons	liters	3.8
milliliters	teaspoons	0.2
milliliters	tablespoons	0.067
milliliters	fluid ounces	0.034
liters	cups	4.2
liters	pints	2.1
liters	quarts	1.06
liters	gallons	0.26
cubic feet	cubic meters	0.028
cubic yards	cubic meters	0.765
cubic meters	cubic feet	35.3
cubic meters	cubic yards	1.31

Area Conversion

When You Know:	You Can Find:	If You Multiply By:
square inches	square centimeters	6.45
square inches	square meters	0.000 6
square feet	square centimeters	9 29
square feet	square meters	0.092 9
square yards	square centimeters	8.360
square yards	square meters	0.836
square miles	square kilometers	2.6
square centimeters	square inches	0.155
square meters	square inches	1 550
square centimeters	square feet	0.001
square meters	square feet	10.8
square centimeters	square yards	0.000 12
square meters	square yards	1.2
square kilometers	square miles	0.4

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APPENDIX III

FORMULAS

CONVERSION FACTORS AND CONSTANTS

$$\begin{array}{ll} \pi = 3.14 & 2\pi = 6.28 \\ \pi^2 = 9.87 & (2\pi)^2 = 39.5 \\ \epsilon = 2.718 & \sqrt{2} = 1.414 \\ \sqrt{3} = 1.732 & \text{LOG} = 0.497 \end{array}$$

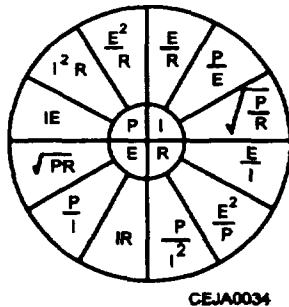
Temperature

$$\begin{array}{l} (\text{F to C}) \text{ C} = 5/9 (\text{F} - 32) \\ (\text{C to F}) \text{ F} = 9/5 \text{ C} + 32 \\ (\text{C to K}) \text{ K} = \text{C} + 273 \end{array}$$

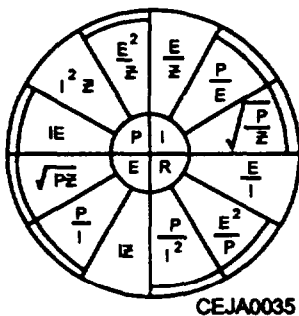
Power

$$\begin{array}{l} 1 \text{ kilowatt} = 1.341 \text{ horsepower} \\ 1 \text{ horsepower} = 746 \text{ watts} \end{array}$$

OHM'S LAW – DIRECT CURRENT



OHM'S LAW – ALTERNATING CURRENT



SINUSOIDAL VOLTAGES AND CURRENTS

$$\begin{array}{l} \text{Effective Value} = 0.707 \times \text{Peak Value} \\ \text{Average Value} = 0.637 \times \text{Peak Value} \\ \text{Peakvalue} = 1.414 \times \text{Effective Value} \\ \text{Effective Value} = 1.11 \times \text{Average Value} \\ \text{Peak Value} = 1.57 \times \text{Average Value} \\ \text{Average Value} = 0.9 \times \text{Effective Value} \end{array}$$

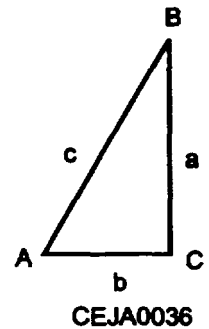
TRIGONOMETRIC FORMULAS

$$\sin A = \frac{a}{c} = \frac{\text{Opposite Side}}{\text{Hypotenuse}}$$

$$\cos A = \frac{b}{c} = \frac{\text{Adjacent Side}}{\text{Hypotenuse}}$$

$$\tan A = \frac{a}{b} = \frac{\text{Opposite Side}}{\text{Adjacent Side}}$$

$$\cot A = \frac{b}{a} = \frac{\text{Adjacent Side}}{\text{Opposite Side}}$$



SPEED VS. POLES FORMULAS

$$F = \frac{NP}{120} \quad N = \frac{F \cdot 120}{P} \quad P = \frac{F \cdot 120}{N}$$

F = frequency

N = speed of rotation

p = number of poles

120 = time constant

POWER FACTOR

$$\text{PF} = \frac{\text{actual power}}{\text{apparent power}} = \frac{\text{watts}}{\text{volts} \times \text{amperes}} = \frac{\text{kW}}{\text{kVA}} = \frac{R}{Z}$$

SINGLE-PHASE CIRCUITS

$$\text{kVA} = \frac{EI}{1,000} = \frac{\text{kW}}{\text{PF}} \quad \text{kW} = \text{kVA} \times \text{PF}$$

$$I = \frac{P}{E \times \text{PF}} \quad E = \frac{P}{I \times \text{PF}} \quad \text{PF} = \frac{P}{E \times I}$$

$$P = E \times I \times \text{PF}$$

TWO-PHASE CIRCUITS

$$I = \frac{P}{2 \times E \times \text{PF}} \quad E = \frac{P}{2 \times I \times \text{PF}} \quad \text{PF} = \frac{P}{E \times I}$$

$$\text{kVA} = \frac{2 \times E \times I}{1,000} \quad \frac{\text{kW}}{\text{PF}} \quad \text{kW} = \text{kVA} \times \text{PF}$$

$$P = 2 \times E \times I \times \text{PF}$$

THREE-PHASE CIRCUITS, BALANCED WYE

$$I_{\text{phase}} = I_{\text{line}}$$

$$E_L = \sqrt{3} E_P = 1.73 E_P$$

$$E_P = \frac{E_L}{\sqrt{3}} = 0.577 E_L$$

THREE-PHASE CIRCUITS, BALANCED DELTA

$$E_{\text{phase}} = E_{\text{line}}$$

$$I_L = \sqrt{3} I_P = 1.73 I_P$$

$$I_P = \frac{I_L}{\sqrt{3}} = 0.577 I_L$$

POWER: THREE-PHASE BALANCED WYE OR DELTA CIRCUITS

$$P = 1.732 \times E \times I \times \text{PF} \quad \text{VA} = 1.732 \times E \times I$$

$$E = \frac{P}{\text{PF} \times 1.73 \times I} = \frac{0.577 \times P}{\text{PF} \times I}$$

$$I = \frac{P}{\text{PF} \times 1.73 \times E} = \frac{0.577 \times P}{\text{PF} \times E}$$

$$\text{PF} = \frac{P}{\text{PF} \times 1.73 \times E} = \frac{0.577 \times P}{I \times E}$$

$$\text{VA} = \text{apparent power (voltamperes)}$$

$$P = \text{actual power (watts)}$$

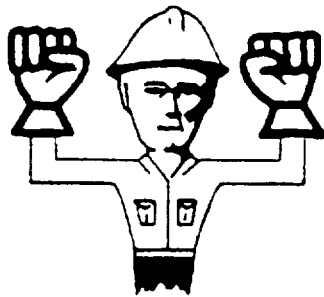
$$E = \text{line voltage (volts)}$$

$$I = \text{line current (amperes)}$$

APPENDIX IV

HAND SIGNALS

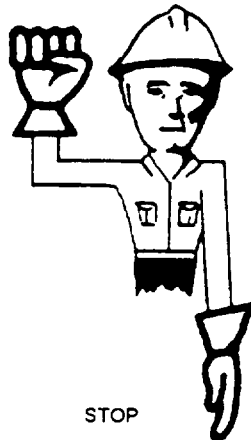
GENERAL



EMERGENCY STOP

(STOP ALL MOTION AS QUICKLY AS POSSIBLE)

1



STOP

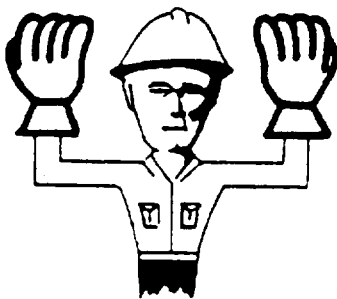
2



KILL ENGINE

(SECURE ENGINE AS PRESCRIBED)

3



MANEUVER FORWARD SLOW AND EASY

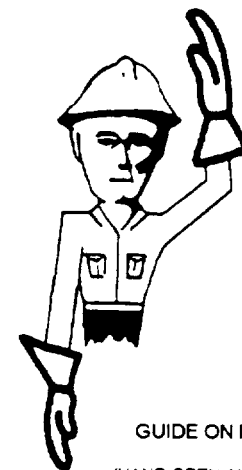
(WHEN MANEUVERING IN CLOSE QUARTERS OR TO MOVE A FOOT OR TWO AT A TIME.)

4



SLOW DOWN

5



GUIDE ON ME

(HAND OPEN AND PALM FACING INWARD)

6

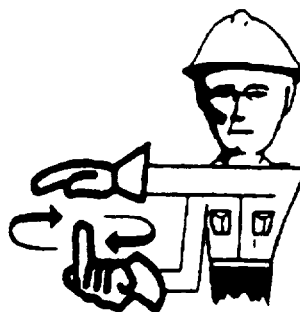


INCREASE SPEED

(HURRY UP AND MOVE OUT. DOUBLE TIME, ETC.)

7

HOISTING & DERRICK SIGNALS



RAISE OR HOIST SLOWLY

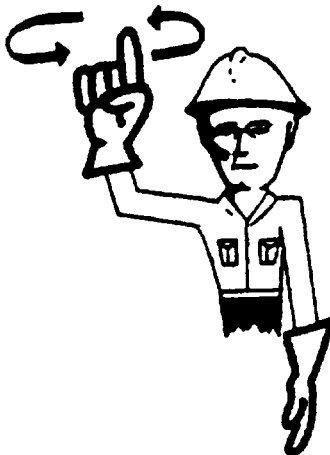


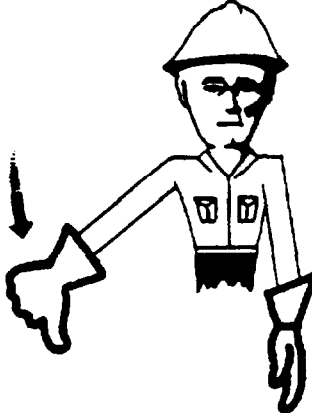

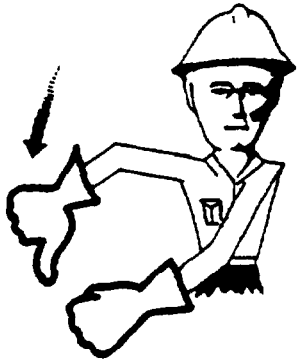
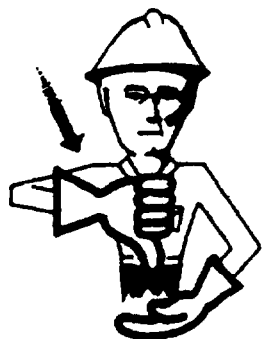

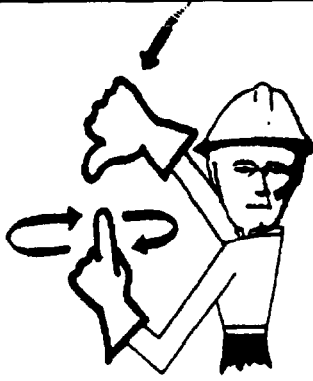
8



LOWER SLOWLY

9

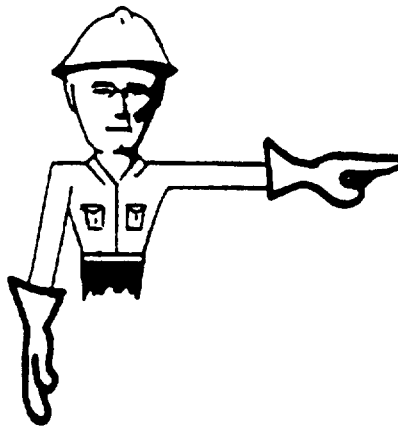
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 <p>10 RAISE THE LOAD</p>	 <p>11 LOWER THE LOAD</p>	 <p>12 RAISE THE BOOM</p>
 <p>13 LOWER THE BOOM</p>	 <p>14 RAISE THE BOOM AND HOLD THE LOAD</p>	 <p>15 LOWER THE BOOM AND HOLD THE LOAD</p>
 <p>16 LOWER THE BOOM SLOWLY</p>	 <p>17 RAISE THE BOOM SLOWLY</p>	 <p>18 LOWER THE BOOM AND RAISE THE LOAD</p>

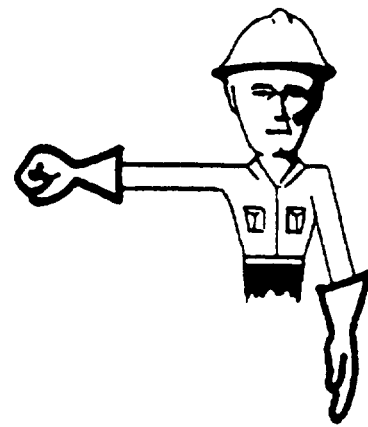
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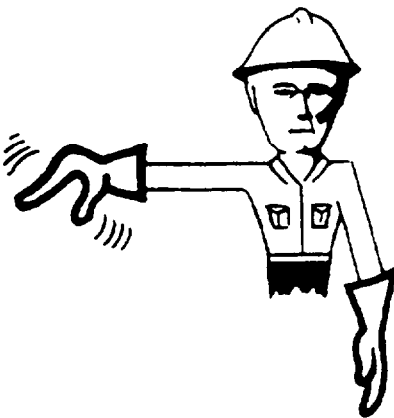
19 RAISE THE BOOM
AND LOWER THE LOAD



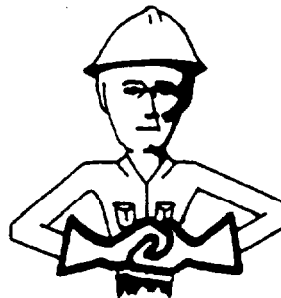
20 SWING IN DIRECTION
FINGER POINTS



21 CLOSE BUCKET



22 OPEN BUCKET



23 DOG EVERYTHING
(LOCK ALL BRAKES; DO NOT
MOVE UNTIL FURTHER
INSTRUCTIONS ARE GIVEN.)

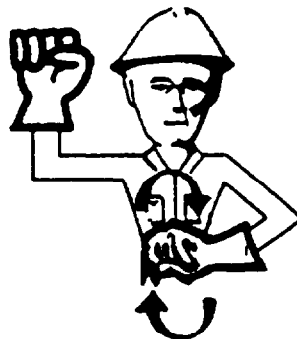


24 USE MAIN HOIST, TAP FIST
ON HEAD, THEN USE REGULAR
SIGNALS.



25 USE WHIP LINE.
(AUXILIARY HOIST) TAP
ELBOW WITH ONE HAND,
THEN USE REGULAR SIGNALS.

CRAWLER EQUIP. (INCLUDES CRANES)



26 LEFT

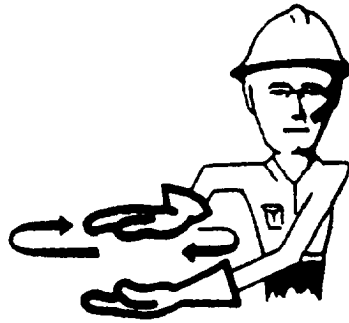


MAKE RIGHT OR LEFT TURN
AS INDICATED BY CLENCHED
FIST.

RIGHT



27 TRAVEL BOTH TRACKS



28

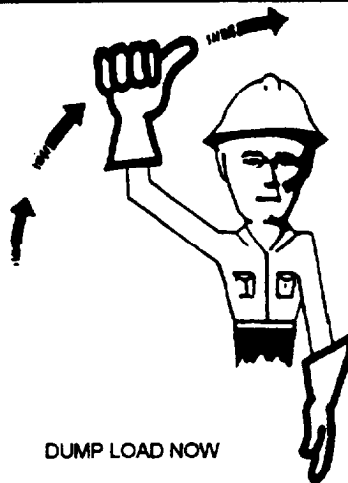
WHEN CUT, FILL OR HAUL ROAD IS TO BE DRAGGED OR BLADED, POINT TO THE AREA, THEN RUB PALMS OF HANDS TOGETHER INDICATING A SMOOTHING MOTION. APPLIES TO SCRAPERS, MOTOR GRADERS AND BULLDOZERS.



29 RAISE A LITTLE



30 LOWER A LITTLE

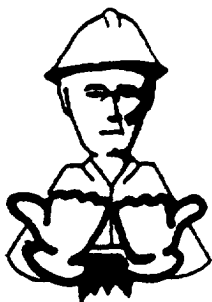


31 DUMP LOAD NOW

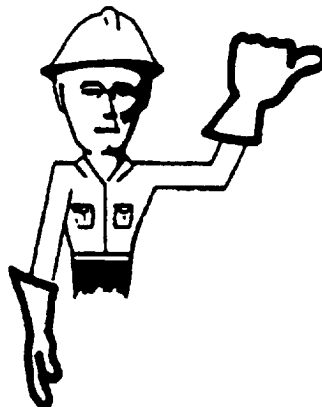
(START DUMPING AND SPREADING LOAD TO PROPER DEPTH IF GIVEN)



32 REHAUL OR RETRACT

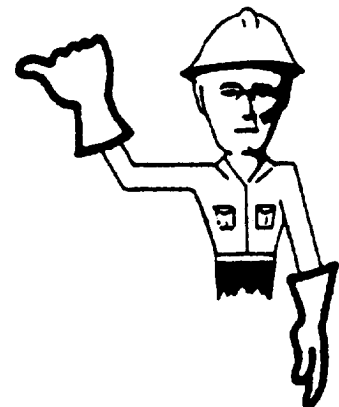


33 CROWD OR EXTEND



34

TURN RIGHT (TO THE OPERATOR'S RIGHT.)



35

TURN LEFT (TO THE OPERATOR'S LEFT.)

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APPENDIX V

REFERENCES USED TO DEVELOP THIS TRAMAN

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. When consulting these references, keep in mind that they may have been revised to reflect new technology or revised methods, practices, or procedures. You therefore need to ensure that you are studying the latest references.

Chapter 1

Hazard Communication, Code of Federal Regulations, 29 CFR 1910.1200, 1991.

Hazardous Material Control and Management, OPNAVINST 4110.2, Office of the Chief of Naval Operation, Washington, DC, 1989.

Seabee Supply Manual, COMCBPAUCOMCBLANTINST 4400.3A, 1987.

Chapter 2

Blueprint Reading and Sketching, NAVEDTRA 12014, Naval Education and Training Program Management Support Activity*, Pensacola, FL, 1994.

Graphic Symbols for Electrical and Electronics Diagrams, American National Standard, ANSI 2.2-1975, The Institute of Electrical and Electronics Engineers, NY, 1986.

Graphic Symbols for Electrical Wiring and Layout Diagrams, American National Standard, ANSI Y32.9-1972, The Institute of Electrical and Electronics Engineers, NY, 1972.

Chapter 3

Croft, Terrell, and Wilford I. Summers, *American Electrician's Handbook* 12th ed., McGraw-Hill, NY, 1992.

McPortland, J.F., and Brian J. McPortland, *National Electrical Code® Handbook*, 22d ed, McGraw-Hill, NY, 1996.

Navy Electricity and Electronics Training Series, Module 1, *Matter Energy, and Direct Current*, NAVEDTRA, B72-01-00-92, Naval Education and Training Program Management Support Activity*, Pensacola, FL, 1992.

Operator and Organization Maintenance Manual for a Generator Set, Diesel Engine Driven, TM5-6115-545-12, 1982.

Chapter 4

Croft, Terrell, and Wilford I. Summers, *American Electrician's Handbook*, 12th ed., McGraw-Hill, NY, 1992.

Electric Power Distribution Systems Operations, NAVFAC MO-201, Naval Facilities Engineering Command, Alexandria, VA, 1990.

Electrical Transmission and Distribution Safety Manual, NAVFAC P-1060, Naval Facilities Engineering Command, Alexandria, VA, 1990.

Kurtz, Edwin B., and Thomas M. Shoemaker, *The Lineman's and Cableman's Handbook*, 8th ed., McGraw-Hill, NY, 1996.

McPortland, J. F., and Brian J. McPortland, *National Electrical Code® Handbook*, 22d ed, McGraw-Hill, NY, 1996.

Chapter 5

Code of Federal Regulation, 29 CFR, 1991.

McPortland, J.E, and Brian J. McPortland, *National Electrical Code® Handbook*, 22d ed, McGraw-Hill, NY, 1996.

National Electrical Code®, National Fire Protection Association, Quincy, MA, 1996.

Chapter 6

Croft, Terrell, and Wilford I. Summers, *American Electrician's Handbook*, 12th ed., McGraw-Hill, NY, 1992.

Kurtz, Edwin B., and Thomas M. Shoemaker, *The Lineman's and Cableman's Handbook*, 8th ed., McGraw-Hill, NY, 1996.

McPortland, J.F., and Brian J. McPortland, *National Electrical Code® Handbook*, 22d ed, McGraw-Hill, NY, 1996.

National Electrical Code®, National Fire Protection Association, Quincy, MA, 1996.

Navy Electricity and Electronics Training Series, Module 8, *Introduction to Amplifiers*, NAVEDTRA 172-08-00-82, Naval Educational Training Program Management Support Activity*, Pensacola, FL, 1982.

Navy Electricity and Electronics Training Series, Module 24, *Introduction to Fiber Optics*, NAVEDTRA B72-24-00-92, Naval Educational Training Program Management Support Activity*, Pensacola, FL, 1992.

Rosenberg, Robert, and August Hand, *Electric Motor Repair*, 3rd ed., Saunders College Publishing, Fort Worth, TX, 1987.

Wire Communications and Signal Systems, MIL-HDBK-1004/7, Department of Defense, Washington, DC, 1991.

Chapter 7

Electrician Systems Technician, AFSC 5425A and B, Department of the Air Force, Extension Course Institute, Gunter Air Force Station, Montgomery, AL, 1993.

McPortland, J.E, and Brian J. McPortland, *National Electrical Code® Handbook*, 22d ed, McGraw-Hill, NY, 1996.

National Electrical Code®, National Fire Protection Association, Quincy, MA, 1996.

* Effective 01 October 1996, the Naval Education and Training Program Management Support Activity (NETPMSA) became the Naval Education and Training Professional Development and Technology Center (NETPDTC).

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